

Claims:

1. A method for creating a measurement report (400) among a plurality of stations (201) in a wireless local area network (WLAN), comprising the steps of:
 - 5 receiving (301) by a measurement capable station (201) of said plurality of stations (201) a measurement request for at least one measurement report element (500) to be made at a given time;
 - recording by the measurement capable station (201) said at least one measurement report element (500);
 - 10 creating by the measurement capable station (201) a measurement report (400) comprising said at least one measurement report element (500) as one of measurement report elements contained therein (405);
 - respectively time-stamping (404, 504) with an absolute time reference at least one of said at least one recorded measurement report element (500) and said measurement
 - 15 report (400); and
 - transmitting (308) by the measurement capable station said created measurement report.
2. The method of claim 1, wherein said time-stamping step further comprises
 - 20 the step of setting by the measurement capable station each said absolute time reference to a time synchronization function (TSF) timer value (306).
3. The method of claim 1, further comprising the steps of:
 - if at least one measurement element has been time-stamped with an absolute time
 - 25 reference (504),

determining by the measurement capable station (201) an earliest said absolute time reference (504) of a measurement report element, and

setting by the measurement capable station (201) said measurement report time-stamp (404) to said determined earliest absolute time reference of a measurement report element.

4. The method of claim 3, wherein said time-stamping step further comprises the step of setting by the measurement capable station (201) each said absolute time to a time synchronization function (TSF) timer value (306).

5. The method of claim 1, wherein said creating step further comprises the step of including in said measurement report a plurality of fields formatted as one of

	Category	Action	Dialog Token	reserved	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	variable

and

	Category	Action	Dialog Token	Time Stamp	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	variable

the fields being -

a Category field (401) that is set equal to a value indicating a Radio Measurement category or Spectrum Management category,

an Action field (402) that is set equal to a value indicating a measurement report (500) is contained therein,

a Dialog Token field (403) that is set equal to a value in a corresponding measurement request or, if the measurement report is not being transmitted in response to a measurement request, is set equal to zero,

an optional Time Stamp field that contains the value of an absolute timer reference (306) at the time when the measurement capable station performed the first measurement of the measurement report elements (405) reported in the measurement report (400), and

a Measurement Report Elements field (405) that contains a number of said measurement report elements 500, said number being at least one, said measurement report elements field (404) having a combined length and a plurality of sub-fields and being formatted as

	Element ID 501	Length 502	Measurement Token 503	Time Stamp 504	Measurement Mode 505	Measurement Type 506	Measurement Report 507
Octets:	1	1	1	8	1	1	variable

the subfields being -

an Element ID subfield (501) that is set to an identifier assigned to the requested Measurement Report,

a Length subfield (502) that is variable with a minimum value of 3,

a Measurement Token subfield (503) that is set equal to a Measurement Token in a corresponding Measurement Request Element of a measurement request or if the Measurement Report Element (500) is being sent autonomously by the measurement capable station then the Measurement Token (503) field is set equal to zero,

an optional Time-Stamp field (505) that is set to the value of an absolute timer (306) when the reported measurement is started,

a Measurement Mode subfield (505) is a bit field that qualifies the type of measurement request being made,

5 a Measurement Type subfield (506) that is set to an identifier that identifies the type of a measurement request, and

a Measurement Report field (507) comprising at least one Measurement Report Element (500),

wherein, at least one of the Measurement Report Time Stamp (404) and a Measurement
10 Element Report Time-Stamp (504) is present.

6. The method of claim 5, wherein:

the WLAN is an IEEE 802.11 WLAN;

15 the Element Id (501) is set to a unique identifier specified by an IEEE 802.11 standard;

each Time Stamp field (404, 504) is a time synchronization function (TSF) timer value (306); and

the combined length of the measurement report elements (405) is less than or equal
20 to the maximum allowed medium access control (MAC) management protocol data unit (MMPDU) size.

7. A method for creating an autonomous measurement report (400) having at least one measurement report element (500), among a plurality of stations (201) in a
25 wireless local area network, comprising the steps of:

recording by a measurement capable station (201) of said plurality of stations (201) at least one pre-determined measurement report element (500);

optionally time-stamping with an absolute time reference by the measurement capable station (201) said at least one recorded measurement report element;

5 creating by the measurement capable station an autonomous measurement report (400) comprising said at least one measurement report element (500);

optionally time-stamping with an absolute time reference of the earliest time of a measurement report element contained therein said autonomous measurement report (400), and

10 transmitting (308) by the measurement capable station said autonomous measurement report (400),

wherein, at least one of said autonomous measurement report time-stamp (504) and said at least one measurement report element time-stamp (404) is included in said autonomous measurement report (400).

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8. The method of claim 7, wherein each said time-stamping step further comprises the step of setting by the measurement capable station (201) each said absolute time-stamp (404, 504) to a time synchronization function (TSF) timer value.

20 9. A method for ensuring correctness of a time reference of a requested measurement among a plurality of stations (STAs) (201) in a wireless local area network (WLAN), comprising the steps of:

transmitting (308) by a first station (201) a request for at least one time-stamped measurement report element to be performed at a given time;

receiving (301) by a second station both the measurement request and a corresponding measurement report (400) comprising the requested at least one measurement report element (500) and at least one time-stamp (404, 504) comprising an absolute time reference of when the measurement (507) recorded therein was done;

- 5 comparing by the second station (201) the given time of the measurement request with the at least one time-stamp (404, 504) to determine correctness of the time-stamp.

10. The method of claim 9, wherein said receiving step further comprises the step of receiving in said measurement report (400) a plurality of fields formatted as one of

	Category	Action	Dialog Token	reserved	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	variable

10

and

	Category	Action	Dialog Token	Time Stamp	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	variable

the fields being -

- 15 a Category field (401) that is set equal to a value indicating a Radio Measurement category or Spectrum Management category;

an Action field (402) that is set equal to a value indicating a measurement report is contained therein;

a Dialog Token field (403) that is set equal to a value in a corresponding measurement request or, if the measurement report is not being transmitted in response to a measurement request, is set equal to zero;

an optional Time Stamp field (404) that contains the value of a timer (306) at the
5 time when the measurement capable station started measuring the first reported measurement;

a Measurement Report Elements (405) field that contains a number of said measurement report elements (500), said number being at least one, said Measurement Report Elements field (405) having a combined length and a plurality of subfields and
10 being formatted as

	Element ID <u>501</u>	Length <u>502</u>	Measurement Token <u>503</u>	Time Stamp <u>504</u>	Measurement Mode <u>505</u>	Measurement Type <u>506</u>	Measurement Report <u>507</u>
Octets:	1	1	1	8	1	1	variable

the subfields being -

an Element ID subfield (501) that is set to an identifier assigned to the requested
15 Measurement Report,

a Length subfield (502) that is variable with a minimum value of 3,

a Measurement Token subfield (503) that is set equal to the Measurement Token in the corresponding Measurement Request element or if the Measurement Report element (500) is being sent autonomously by the measurement capable station (201) then the
20 Measurement Token field (503) is set equal to zero,

an optional Time-Stamp field (505) that is set to the value of an absolute timer (306) when the reported measurement is started for each measurement element reported in a Measurement Report Frame,

a Measurement Mode field (505) is a bit field that qualifies the type of measurement report being made,

a Measurement Type field (506) that is set to a number that identifies the type of a measurement being reported; and

5 a Measurement Report field (507) that contains the reported measurement, wherein at least one of the Measurement Report Time Stamp and Measurement Element Report Time Stamps is present.

11. The method of claim 10, wherein:

10 the WLAN is an IEEE 802.11 WLAN;
the Element Id (501) is set to a unique identifier set by an IEEE 802.11 standard;
each said Time Stamp (504) is a time synchronization function (TSF) timer value (306); and

the combined length of the measurement report elements is less than or equal to the
15 maximum allowed medium access control (MAC) management protocol data unit (MMPDU) size.

12. The method of claim 10, wherein said receiving (301) step further comprises the step of receiving a measurement report having each said Time Stamp (404,
20 405) set using a time synchronization function (TSF) timer value (306).

13. An apparatus configured for resource measurement among a plurality of stations in a wireless local area network (WLAN), comprising:

a receiver (301) for receiving an incoming signal;

a measurement acquisition circuit (303) that measures resources of said incoming signal received therein as at least one measurement report element (500);

a timer (306) that provides an absolute time reference;

a control processor (305), coupled to said measurement acquisition circuit (303) and said timer (306) and beginning at a predetermined absolute time, configured to acquire at least one measurement report element of said incoming signal and optionally associate one of (1) an absolute time reference (306) of the start of the first measurement reported (500) within a measurement report (400) as a time-stamp (404) and (2) an absolute time reference (306) of the start of each measurement report element reported therein (507) with a measurement report element time-stamp (504).

14. The apparatus of claim 13, further comprising:

a memory (304), coupled to said control processor (305) to store said obtained measurement report elements (500) and optionally said associated measurement report element time-stamps (504); and

wherein, said control processor (305) is further configured to compare the predetermined absolute time with at least one said absolute time-stamp (404, 504) to determine correctness of said at least one absolute time-stamp (404, 504).

15. The apparatus of claim 14, further comprising a transmitter that transmits a measurement report comprising a plurality of fields formatted as one of

	Category	Action	Dialog Token	reserved	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	Variable

and

	Category	Action	Dialog Token	Time Stamp	Measurement Report Elements
	<u>401</u>	<u>402</u>	<u>403</u>	<u>404</u>	<u>405</u>
Octets:	1	1	1	8	variable

the fields being -

5

a Category field (401) that is set equal to a value indicating a Radio Measurement category or Spectrum Management category;

an Action field (402) that is set equal to a value indicating a measurement report is contained therein;

10

a Dialog Token field (403) that is set equal to a value in a corresponding measurement request or, if the measurement report is not being transmitted in response to a measurement request, is set equal to zero;

an optional Time Stamp field (404) that contains the value of a timer (306) at the time when the measurement capable station started measuring the first reported

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measurement;

a Measurement Report Elements 405 field that contains a number of said measurement report elements (500), said number being at least one, said Measurement Report Elements field (405) having a combined length and a plurality of subfields and being formatted as

	Element ID	Length	Measurement Token	Time Stamp	Measurement Mode	Measurement Type	Measurement Report
	<u>501</u>	<u>502</u>	<u>503</u>	<u>504</u>	<u>505</u>	<u>506</u>	<u>507</u>
Octets:	1	1	1	8	1	1	variable

the subfields being -

- an Element ID subfield (501) that is set to an identifier assigned to the requested
- 5 Measurement Report,
 - a Length subfield (502) that is variable with a minimum value of 3,
 - a Measurement Token subfield (503) that is set equal to the Measurement Token in the corresponding Measurement Request element or if the Measurement Report element (500) is being sent autonomously by the measurement capable station (201) then the
 - 10 Measurement Token field (503) is set equal to zero,
 - an optional Time-Stamp field (504) that is set to the value of an absolute timer (306) when the reported measurement is started for each measurement element reported in a Measurement Report Frame,
 - a Measurement Mode field (505) is a bit field that qualifies the type of
 - 15 measurement report being made,
 - a Measurement Type field (506) that is set to a number that identifies the type of a measurement being reported; and
 - a Measurement Report field (507) that contains the reported measurement,
 - 20 wherein at least one of the Measurement Report Time Stamp and Measurement Element Report Time Stamps is present.

16. The apparatus of claim 15, wherein:
the WLAN is an IEEE 802.11 WLAN;
the Element Id (501) is set to a unique identifier specified by an IEEE 802.11
5 standard;
each said Time-Stamp (404, 504) is a time synchronization function (TSF) timer
value (306); and
the combined length of the measurement report elements is less than or equal to the
maximum allowed medium access control (MAC) management protocol data unit
10 (MMPDU) size.

17. The apparatus of claim 15, further comprising a receiver (301) for receiving
a measurement request comprising at least one measurement request element to be
measured and reported as a measurement report element (500) and the predetermined time
15 to start measuring.

18. The apparatus of claim 17, wherein said measurement request is transmitted
by a station (201) of said plurality of stations (201).

20 19. The apparatus of claim 17, wherein said measurement request is transmitted
by an access point (200) of said plurality of stations (201).